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ABSTRACT

This is the student guide in a set of five computer-oriented environmental/energy education units. Contents are organized into the following parts or lessons: (1) Introduction to the U.S. Energy Future; (2) Description of the "FUTURE" programs; (3) Effects of "FUTURE" decisions; and (4) Exercises on the U.S. energy future. This guide supplements a computer simulation that students can use to study the effects of their energy decisions. (ER)

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ED167366

COMPUTER TECHNOLOGY PROGRAM
ENVIRONMENTAL EDUCATION UNITS

OUR U.S. ENERGY

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FFFFF   U   U  TTTTT  U   U   RRRRR   EEEEE
F       U   U    T    U   U   R   R   E
F       U   U    T    U   U   R   R   E
FFFF    U   U    T    U   U   RRRRR   EEEE
F       U   U    T    U   U   R R     E
F       U   U    T    U   U   R  R    E
F        UUU     T     UUU    R   R   EEEEE
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STUDENT GUIDE

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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This edition is based on earlier developmental work conducted with a limited test sample. The material was reviewed in order to correct any noted technical errors prior to printing of the October 1977 edition. However, purchasers are urged to first run the sample simulation program provided in order to determine any needed or desired adjustments prior to actual use. The Laboratory would appreciate hearing from users concerning any suggestions for corrections to subsequent editions.

First Printing, October 1977

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TO THE STUDENT

In this unit, you will study some of the most important options which the United States has for solving our present and future energy problems. In particular, you will become familiar with the 13 main energy-related decisions proposed for Project Independence by President Ford in his 1975 "State of the Union Address" to secure our energy future. Although Project Independence is several years old, its goals address energy problems which still confront our country today. President Carter also has energy independence as one of the top priorities in his administration. Thus, even though President Carter's energy plan is slightly different from President Ford's, it is still generally appropriate to study Project Independence as an example of a comprehensive energy plan for the country. Using the computer simulation called FUTURE, you will study the probable effects of these decisions and develop your own plan of action for securing our energy future between now and the year 1985.

When you have completed this unit, you will be able to:

1. List the goals and options defined in Project Independence.
2. Describe the effect of each option on
    a. energy supply and consumption
    b. domestic production of oil, natural gas, and coal
    c. pollution
3. Describe the relative effects of increasing energy supply and reducing energy demand on
    a. total energy consumption
    b. domestic production and reserves of oil, natural gas, and coal
    c. pollution
4. Outline an energy plan which optimizes the trade-off between reducing dependence on imported fuel and level of pollution.

INTRODUCTION TO THE U.S. ENERGY FUTURE

The Complexity of the Problem

Today we are all aware that the energy problem in America and the world is serious. We either experienced or read about the long lines at gas stations during the winter of 1973-1974 following the Arab oil embargo. We have seen prices for gasoline, fuel oil, natural gas, coal and electricity increase dramatically, almost doubling in a few years. The rise in the price of energy of all kinds has caused a rise in the price of all other goods and services.

A possible result of decreased energy supplies is that production slows down and increasing numbers of people are laid off from work, creating a greater unemployment problem. To add to the seriousness of the entire situation, current energy forecasts predict that our major energy sources, oil and natural gas, may be nearly gone within several decades.

If we hope to solve the energy problem, we are going to have to make some important decisions. In working with this unit, you will be confronted with the great complexity of the energy-related decisions that must be made within the next 10 years. Using the computer simulation of the energy situation called FUTURE, you will be in the position of the highest decision maker in the country, the president; you will be weighing issues and making the kinds of decisions the president is now making, decisions which will determine our energy future.

The Elements of Decision-Making

When you make any decision, you are choosing from among several options or alternative courses of action. Your choice is guided by your desire to reach a goal; you choose the options that you think will lead you to your goal. Suppose that your goal is to buy a car that is relatively inexpensive, dependable, and gets good gasoline mileage. Your options would probably include most new and late-model compact cars. Your decision would consist of choosing from among these options.

Two factors influence the difficulty of decisions. The first is the number of options from which a choice must be made--the greater the number of options, the greater the difficulty of the decision. If you wanted to buy a compact car, your decision would be easy if there were only 2 for sale, but would be very difficult if there were 100 for sale.

The second factor influencing the difficulty of decisions is the number of criteria for choosing the best option--the greater the number of criteria, the greater the difficulty of the decision. The reason for this is that options usually do not meet all of the criteria. In the case of buying a car, for example, the least expensive car might not be the most dependable or get the best gasoline mileage.

In this situation you are faced with something called a trade-off--you must trade one criterion for another. In our example, you may have to sacrifice dependability in order to obtain the lowest priced automobile possible. If dependability is your major criterion, you will probably have to spend more money.

Most of the time we try to optimize our trade-off. Instead of concentrating on one of the criteria and ignoring the others, we try to strike a balance among the criteria so that we partially meet each one. We might pay a little more for a car in order to get a little more dependability and a little better mileage. How much more we would pay depends on how much we value dependability and mileage relative to expense. If we value dependability and mileage as very important, we might well pay more to obtain it. If low cost is our most important criterion, we would pay less and accept less dependability and mileage.

Decision theorists have developed mathematical equations which calculate optimum decisions from our values. If you are mathematically inclined, you might want to read some of the papers on decision theory listed at the end of this booklet.

President Ford's 1975 Energy-Related Decisions

Part of President Ford's 1975 State of the Union Address is printed at the end of this booklet. In this speech, he described energy-related goals and discussed some of the decisions which might help us reach these goals. What are the goals and decision options? We have summarized them in Fig. 1 on page 5.

There is one main goal: to reduce our dependence on imported fuel. In order to reach this goal, President Ford defined two subgoals: (1) to increase our domestic supply of oil, and (2) to reduce our consumption of oil and natural gas. In order to reach these subgoals, President Ford proposed several possible decisions or options. To increase our domestic supply of oil, he proposed drilling new wells on the continental shelf and on the Naval reserves at Elk Hills, California and in Alaska, and producing synthetic oil and gas from coal and shale. To reduce our consumption of oil and natural gas, he proposed the conversion of electric utilities from oil and natural gas to coal, increasing the price of oil and natural gas by imposing tariffs on imported fuel and deregulating prices, producing cars that get 40% better

mileage, encouraging better insulation of homes and office buildings, and building more nuclear power plants. He temporarily rejected the options of increasing the price of gasoline by a consumer-paid excise tax and reducing the supply by either rationing or allocation.

Using the computer program called FUTURE you will be able to try out these energy-related options and to observe their results on U.S. energy supply and demand.

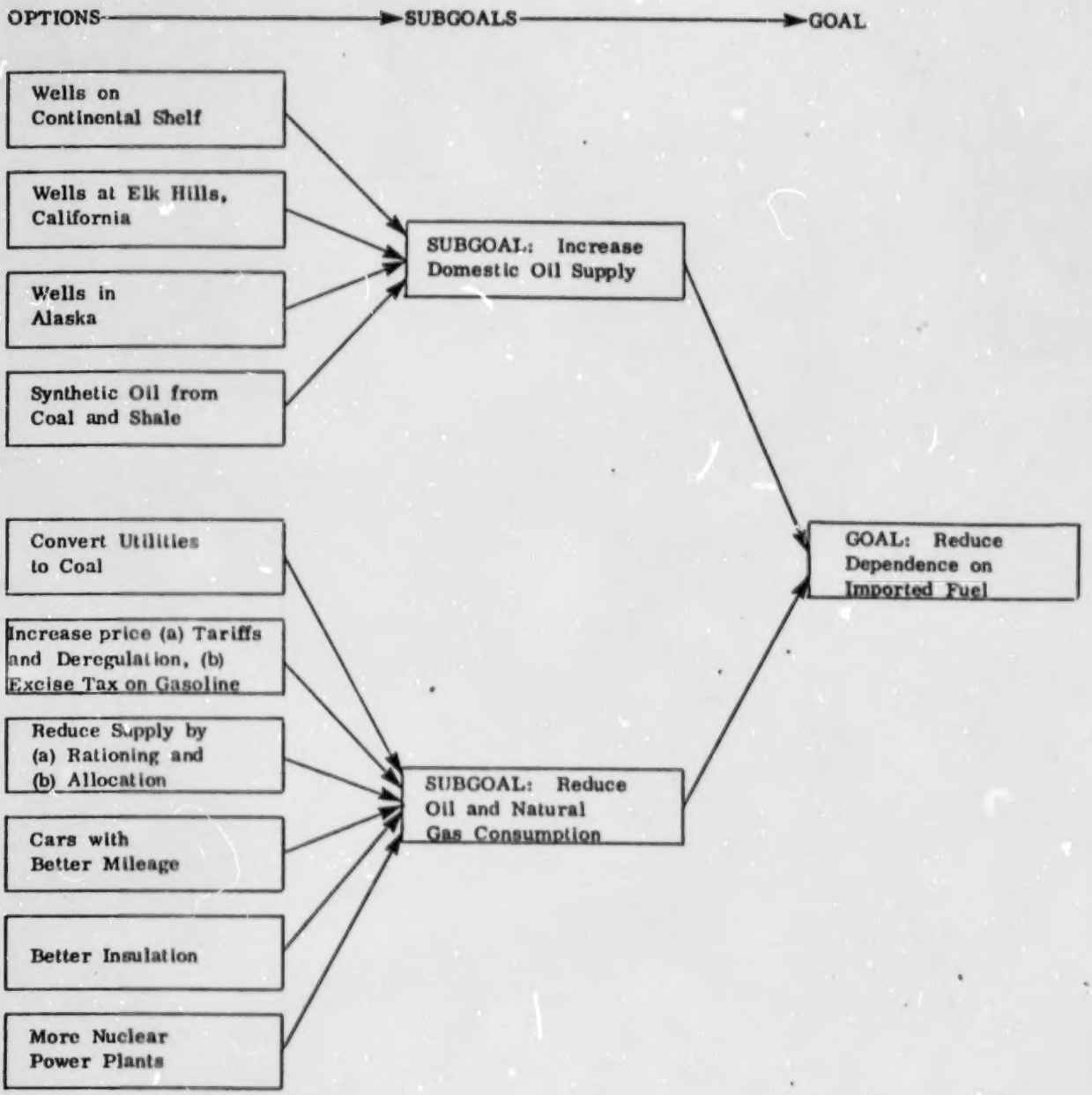
OPTIONS
SUBGOALS
GOAL
Wells on Continental Shelf
Wells at Elk Hills, California
Wells in Alaska
Synthetic Oil from Coal and Shale
Convert Utilities to Coal
Increase price (a) Tariffs and Deregulation, (b) Excise Tax on Gasoline
Reduce Supply by (a) Rationing and (b) Allocation
Cars with Better Mileage
Better Insulation
More Nuclear Power Plants
SUBGOAL: Increase Domestic Oil Supply
SUBGOAL: Reduce Oil and Natural Gas Consumption
GOAL: Reduce Dependence on Imported Fuel

Fig. 1. Energy-Related Goals and Options of Project Independence.

5

DESCRIPTION OF THE "FUTURE" PROGRAM

The FUTURE program allows the user to select among thirteen energy-related decisions. As a result of the decisions selected, the program simulates the energy supply and consumption in the United States for the years 1975 to 1985. It calculates energy supply from five sources: oil, natural gas, coal, hydropower, and nuclear power, and energy consumption for five main groups of energy consumers: industry, electric utilities, transportation, residential/commercial, and nonenergy uses (dyes, plastics, paints, drugs, and so forth). Pollution effects of various kinds are also calculated and listed for 1985 for each run.

The program begins with clear instructions on how to run it, and lists the thirteen decisions which the user can choose among.

The Decision Options

With the FUTURE program, the user can select energy-related decisions from the following 13 options:

1. New oil wells on the outer continental shelf.

   These are off-shore wells drilled along our eastern and western coasts.

2. Wells on the naval reserve at Elk Hills, California

   This is a reserve created by President Taft in 1912 to serve as an emergency supply of fuel for the Navy.

3. New oil wells on the Alaskan naval reserves.

   This was created in 1923 by President Harding as part of an attempt to quiet criticism following the Teapot Dome Scandal.*

4. Produce synthetic oil and gas from coal and shale.

   Synthetic oil and gas can be produced from coal by processes called coal liquifaction and gasification. Oil can be extracted from oil shale, a kind of rock found in Colorado, Utah and Wyoming.

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* The Teapot Dome is an oil reserve located in Wyoming. President Harding's Interior Secretary, Albert Fall, leased the reserve to private companies and was convicted of taking a bribe from oilmen. The Teapot Dome Scandal was the Watergate of its time.

5. Convert utilities from oil and gas to coal.

Some of the electric utilities now using oil or natural gas as fuel could use coal instead if pollution requirements were eased and if new equipment were installed.

6. Increase the price of oil and natural gas by taxing imported and domestic oil and gas and deregulating the price of domestic oil and gas.

A tax or tariff on domestic and imported crude oil and natural gas would be passed on to users, e.g., oil companies and other industries, increasing the price of all oil products and natural gas. The price of domestic oil and natural gas is now regulated or controlled by the government. If it were deregulated, the price would increase.

7. Increase the price of gasoline by a direct excise tax at the pump.

This would be a tax on gasoline rather than on the crude oil from which gasoline is produced. It would be paid directly by the buyer at service stations (at the pump) rather than by the oil companies.

8. Reduce the supply of gasoline by rationing.

Each person would be allowed to purchase a certain ration or allotment of gasoline each month. If the allotment were exceeded, the person would have to pay a penalty.

9. Reduce the supply of gasoline by allocation.

Service stations in a geographical area would receive a certain allotment of gasoline each month. Stations would probably have fewer hours each day during which gasoline was sold and would limit sales in other ways in order to make the allotment last through the month.

10. Produce cars with 40% better mileage.

Modifying car designs, especially producing lighter weight cars, is expected to enable manufacturers to improve new car mileage 25 to 40% from 1974 levels.

11. Encourage better insulation in homes and businesses.

Legislation to make thermal efficiency standards mandatory for all new buildings, a tax credit for homeowners installing insulation, and a program to help low income families purchase insulation are all expected to increase the use of insulation.

12. Encourage more efficient appliances.

As energy costs rise and supplies become scarcer, it becomes very important for the consumer to consider not only the initial

price of an appliance, but also its "energy cost." Combining cost savings with the need to conserve energy resources gives strong emphasis to the need for using the most efficient appliance available.

13. Increase the number of nuclear power plants.

    More nuclear power plants would mean fewer electrical utilities using oil and natural gas and thus a decrease in the consumption of oil and gas.

The user also has the option of entering no decisions and seeing the effects that no decisions have on the energy supply and consumption situation.

The FUTURE Display of Data

After the user has entered his or her energy decisions, the program will ask how often the user wants information to be displayed. Information can be displayed for:

1. All years from 1975 to 1985
2. Only 1975 and 1985
3. Only 1985

We recommend either 2 or 3 since 1 requires 20 minutes to print.

Information for each year is displayed in the format shown below.

1975

	SOURCE						
USER	OIL	GAS	COAL	HYDRO	NUCLEAR	TOTAL	PERCENT
INDUSTRY	6.4	10.6	4.0	0.0	0.0	21.0	25.6
ELEC UTIL	2.6	4.1	8.9	3.6	2.6	21.8	26.6
TRANSPORT.	18.6	0.7	0.0	0.0	0.0	19.3	23.5
RES./COM'L.	7.0	7.6	0.4	0.0	0.0	15.0	18.3
NONENERGY	3.9	0.7	0.2	0.0	0.0	4.8	5.8
SOURCE TOTAL	38.5	23.7	13.5	3.6	2.6	81.9	
PERCENT	47.0	28.9	16.4	4.3	3.1		
DOMESTIC	24.2	21.3	13.5				
PERCENT	62.8	89.8	100.0				

DOMESTIC RESERVES

FUEL	BTU X 10:15	YEARS AT 1975 RATE
OIL	555.8	22.9669
GAS	1010.7	47.4507
COAL	40946.5	3033.07

The printout shows the display for the year 1975 when no decisions are made. As you can see, the first part of the display is a table containing data on total U.S. energy consumption. The table has five rows and five columns. The rows are the different users or consumers of energy: industry, electrical utilities, transportation, residential/commercial, and nonenergy uses. The columns are the different sources of energy: oil, natural gas, coal, hydropower, and nuclear power. The numbers in the table are the number of British thermal units* times 10 to the 15th power (BTU x 10^{15})** of energy from an energy source consumed by a user. For example, industry consumed 6.4 x 10^{15} BTU's of energy supplied by oil and 10 x 10^{15} BTU's of energy supplied by gas.

At the end of each row and column "TOTAL" figures are shown; the "TOTAL" figure to the right of each row represents total energy consumed by each user identified at the beginning of each row, and the "SOURCE TOTAL" figure at the bottom of each column represents the total energy consumption from each source (oil, gas, etc.). For example, reading the "TOTAL" figure at the right of the first row, you can see that industry consumed a total of 21.0 x 10^{15} BTU's in 1975. Reading the "TOTAL" figure at the bottom of the column representing oil, you can see that oil supplied 38.5 x 10^{15} BTU's of the energy used by the five major consumers in 1975. At the bottom of the "TOTAL" column, and the right hand end of the SOURCE TOTAL row, is the grand total of all energy consumed in 1975--81.9 x 10^{15} BTU's.

To the right of each "TOTAL" figure is a "PERCENT" figure, which represents the percentage of the grand total consumed by each user. Reading the "PERCENT" figure at the right side of the first row, you can see that industry consumed 25.6% of the total energy consumed in 1975. Similarly, reading the "PERCENT" figure at the bottom of the first column, you can see that oil consumption constituted 47% of the total energy consumption in 1975.

The second part of the display contains data on the consumption and reserves of domestic nonrenewable energy sources (oil, gas, and coal). These data show the amount of oil, gas, and coal produced domestically (from United States reserves), the percentage of oil, gas, and coal consumption supplied by domestic production, and the impact of domestic production on our reserves of oil, gas, and coal. Oil, gas, and coal are called "nonrenewable" resources because they cannot be renewed. We can't make oil, gas, and coal to replace what we use. The data in our example shows that domestic oil reserves supplied 24.2 x 10^{15} BTU's, which is 66.7% of the source (oil) total of

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* A British thermal unit is a measure of energy. It is the amount of heat required to raise one pound of water one degree Fahrenheit. See the Table of Conversions at the end of the booklet for the relation of barrels of oil, cubic feet of gas and tons of coal to BTU's.

** 1 x 10^{15} BTU's = 1,000,000,000,000,000 BTU's = 1 Quadrillion BTU's

36.3×10^{15} BTU's. This leaves a reserve of 555.8×10^{15} BTU's of oil which will last for 22.9669 years assuming the 1975 rate of consumption.

A Sample Run

A sample run of Program FUTURE is printed on the following pages. The words and numbers typed by the user are underlined for easy identification (they are not underlined in a real run of the program). Note that some of the totals are in error by .1 or .2 $\times 10^{15}$ BTU's; this is due to rounding error in printing. The totals stored in the computer are accurate.

In this sample run, no decisions were entered at the outset and the displays for 1975 and 1985 were chosen. Following the display of total U.S. energy consumption and domestic nonrenewable energy, data on air pollution, land waste, water pollution, and radioactive waste are printed. These data are printed after the displays for every run. They show the effects of decisions on the environment in 1975 and 1985.

Sample Run of FUTURE

```
GET-FUTURE
HEN
FUTURE

DO YOU NEED INSTRUCTIONS?YES

THIS IS A SIMULATION OF ENERGY SUPPLY AND CONSUMPTION IN THE
UNITED STATES FOR THE YEARS 1975 TO 1985.  IT ALLOWS YOU TO MAKE
THE KIND OF ENERGY-RELATED DECISIONS FACING OUR COUNTRY IN 1975
AND TO SEE THE EFFECT OF YOUR DECISIONS ON OUR ENERGY FUTURE.
YOU WILL BE ABLE TO SEE HOW YOUR DECISIONS AFFECT OUR TOTAL ENERGY
CONSUMPTION, THE PERCENTAGE OF THE TOTAL CONSUMED BY INDUSTRY,
ELECTRIC UTILITIES, TRANSPORTATION, RESIDENTIAL AND COMMERCIAL
USERS, AND NONENERGY USES.  YOU WILL ALSO SEE HOW YOUR DECISIONS
AFFECT THE PERCENTAGES OF TOTAL ENERGY OBTAINED FROM DOMESTIC
SOURCES AND HOW THE USE OF DOMESTIC SOURCES AFFECTS OUR RESERVES
OF OIL, GAS, AND COAL.

YOU CAN MAKE ANY COMBINATION OF DECISIONS FROM THE 13 POSSIBLE
DECISIONS LISTED BELOW.  AFTER YOU SEE THE LIST, YOU WILL BE ASKED
TO ENTER YOUR DECISIONS AND A QUESTION MARK WILL BE TYPED.  ALL
YOU HAVE TO DO IS TYPE THE NUMBER CORRESPONDING TO A DECISION YOU
WANT TO MAKE AND THEN PRESS THE CARRIAGE RETURN BUTTON.  QUESTION
MARKS WILL KEEP APPEARING UNTIL YOU ENTER A '0' (ZERO).  AFTER
YOU ENTER YOUR ENERGY DECISIONS YOU WILL BE ASKED TO INDICATE
HOW OFTEN YOU WANT TO SEE INFORMATION DISPLAYED.  YOU CAN
SEE (1) ALL YEARS FROM 1975 TO 1985, (2) ONLY 1975 AND 1985, OR
(3) ONLY 1985.  WE RECOMMEND EITHER (2) OR (3) SINCE (1) REQUIRES
20 MINUTES TO PRINT.

THE NUMBERS THAT WILL BE PRINTED ARE EITHER PERCENTAGES OR
BRITISH THERMAL UNITS (BTU) TIMES 10 TO THE 15TH POWER.


POSSIBLE DECISIONS

1.  NEW OIL WELLS ON THE OUTER CONTINENTAL SHELF.

2.  WELLS ON THE NAVAL RESERVE AT ELK HILLS, CALIF.

3.  NEW OIL WELLS ON THE ALASKAN NAVAL RESERVES.

4.  PRODUCE SYNTHETIC OIL FROM COAL AND SHALE.

5.  CONVERT UTILITIES FROM OIL AND GAS TO COAL.

6.  INCREASE PRICE OF OIL AND NATURAL GAS BY TAXING IMPORTED AND
    DOMESTIC OIL AND GAS AND DEREGULATING THE PRICE OF DOMESTIC
    OIL AND GAS.
```

7. INCREASE PRICE OF GASOLINE BY DIRECT EXCISE TAX AT THE PUMP.

8. REDUCE SUPPLY OF GASOLINE BY RATIONING.

9. REDUCE SUPPLY OF GASOLINE BY ALLOCATION.

10. PRODUCE CARS WITH 40% BETTER MILEAGE.

11. ENCOURAGE BETTER INSULATION IN HOMES.

12. ENCOURAGE MORE EFFICIENT APPLIANCES.

13. INCREASE THE NUMBER OF NUCLEAR POWER PLANTS.

ENTER YOUR DECISIONS
?0

HOW OFTEN DO YOU WANT INFORMATION DISPLAYED?
1 = ALL YEARS, 2 = 1975 AND 1985, 3 = ONLY 1985.?2

1975

	SOURCE						
USER	OIL	GAS	COAL	HYDRO	NUCLEAR	TOTAL	PERCENT
INDUSTRY	6.4	10.6	4.0	0.0	0.0	21.0	25.6
ELEC UTIL	2.6	4.1	8.9	3.6	2.5	21.8	26.6
TRANSPORT.	18.6	0.7	0.0	0.0	0.0	19.3	23.5
RES./COM'L.	7.0	7.6	0.4	0.0	0.0	15.0	18.3
NONENERGY	3.9	0.7	0.2	0.0	0.0	4.8	5.8
SOURCE TOTAL	38.5	23.7	13.5	3.6	2.6	81.9	
PERCENT	47.0	28.9	16.4	4.3	3.1		
DOMESTIC	24.2	21.3	13.5				
PERCENT	62.8	89.8	100.0				

DOMESTIC RESERVES

FUEL	BTU X 10:15	YEARS AT 1975 RATE
OIL	555.8	22.9669
GAS	1010.7	47.4507
COAL	40946.5	3033.07

1985

USER	SOURCE OIL	GAS	COAL	HYDRO	NUCLEAR	TOTAL	PERCENT
INDUSTRY	8.0	13.2	5.0	0.0	0.0	26.3	19.7
ELEC UTIL	5.6	8.9	19.3	7.8	5.6	47.3	35.5
TRANSPORT.	29.1	1.0	0.0	0.0	0.0	30.2	22.6
RES./COM'L.	9.3	10.1	0.5	0.0	0.0	20.0	15.0
NONENERGY	7.8	1.4	0.4	0.0	0.0	9.6	7.2
SOURCE TOTAL	60.0	34.8	25.2	7.8	5.6	133.4	
PERCENT	45.0	26.1	18.9	5.8	4.2		
DOMESTIC	29.8	28.2	25.2				
PERCENT	49.6	80.8	100.0				

DOMESTIC RESERVES

FUEL	BTU X 10↑15	YEARS AT 1985 RATE
OIL	288.	9.66443
GAS	761	26.9858
COAL	40752.4	1610.86

DO YOU WANT TO RUN THE SIMULATION AGAIN?NO

DONE

THE EFFECTS OF "FUTURE" DECISIONS

Primary Effects of Decisions

At the beginning of this booklet, in our discussion of decisions, we said that there were two factors that influence the difficulty of decisions:

1. The number of options
2. The number of possible criteria for choosing the best options.

Energy-related decisions clearly involve a very large number of options. FUTURE provides for any combination of 13 possible decisions.

Energy-related decisions also involve a large number of possible criteria for choosing the best options. The obvious criterion is that the decisions help us to reach the goal of reduced dependence on imported fuel. This criterion is associated with the primary, energy-related effects of the decisions:

1. The effect on total energy consumption
2. The effect on the percentage of total energy consumed by the different users
3. The effect on the percentage of total energy obtained from domestic sources
4. The effect on domestic reserves of oil, gas, and coal

There are other criteria, however, which are associated with the secondary effects of the decisions, effects which are related to economics (inflation) and the environment (pollution).

Secondary Effects of Decisions

Economic Effects

The options that have the greatest potential impact on the economy are those that seek to reduce our consumption of oil by increasing its price and thus reducing demand (Decisions 6 and 7 in Program FUTURE). Many see these options, especially that corresponding to Decision 6, as inflationary and believe that a better approach to reducing our consumption of oil would be to decrease the supply by rationing or allocation (Decisions 8 and 9). The case for each decision is discussed below.

Decision 6: Increase the price of oil and natural gas by tariffs and deregulation. This option involves imposing tariffs or taxes on all crude oil and natural gas. The increased price of fuel produced by these measures would first be passed on to the primary consumers of fuel--to the oil companies, electrical utilities, and industry. The price increases would then be passed on to individual citizens in the form of higher prices for the products of the primary consumers--gasoline, fuel oil, natural gas, electricity, and the goods and services produced by industry.

These higher prices would undoubtedly cause greater inflation but might reduce the consumption of fuels, including gasoline, because higher prices would not be deductible from federal income tax.

Another effect of higher prices would be increased profits for oil companies. This would enable the oil companies to expand their exploration for new oil sources, to expand their fuel production capacity, and to develop alternatives such as geothermal energy, oil shale, and coal gasification and liquifaction.

Decision 7: Increase the price of gasoline by direct gasoline taxes.

Rather than imposing a tax on all fuel which is passed on to individual citizens through higher prices for goods and services produced by primary consumers, a tax would be imposed on gasoline and paid directly by the individual citizen as he buys gasoline in a service station.

Since the price increase would be restricted to gasoline rather than applying to all of the goods and services produced by primary consumers, the increase in the rate of inflation might be lower than with Decision 6. In addition, direct gasoline taxes are deductible from federal income tax.

Direct gasoline taxes would not increase oil company profits, however, since the taxes would be paid to the federal government. Because of this, there might be less incentive for oil companies to produce more fuel by increased exploration, expanding production capacity, or developing new energy sources. The federal government could support these activities, of course, but this would mean new taxes or a drastic revision of federal spending priorities.

Decisions 8 and 9: Reduce the supply of gasoline by rationing or allocation. These options reduce the consumption of gasoline by reducing the supply--you obviously can't consume what you don't have. There are two ways to reduce the supply of gasoline: rationing and allocation. With rationing, individual citizens are allowed to purchase a limited amount of gasoline, say 10 gallons per week. The rationing would be administered by the federal government and, according to Presidential advisors, would require a bureaucracy of 17,000 persons and $40 billion a year. With allocation, the service stations in each geographical area of the country would be supplied with a certain number of gallons of gasoline each month. When a station sells its supply, it can sell no more until the next month. This leads to reducing the number of hours gasoline is sold each day and the number of days gasoline is sold each week. * This in turn leads to long lines at gasoline stations and an inconvenience for individual citizens.

Rationing or allocation would not cause an increase in the profits of oil companies. Like Decision 7, then, Decisions 8 and 9 would produce less incentive for the production of more fuel.

Environmental Effects

Following the display for the year 1985, FUTURE prints data showing the pollution produced by your decisions. There are four main categories of pollution:

1. Air pollution involves tons of carbon dioxide, carbon monoxide, sulfur dioxide, nitrous oxides, particulates, hydrocarbons, and aldehydes produced by the consumption of oil, gas and coal. Carbon dioxide is by far the greatest pollutant; it is produced by a combustion process. It accounts for about 97% of all air pollution, but it is also relatively harmless. The potential threat of carbon dioxide is the "greenhouse effect." An increase in the carbon dioxide causes heat to be trapped in the earth's atmosphere. The resulting increase in the temperature of the earth could cause disastrous climatological changes.

   Particulates, particles of dust and liquid, have a kind of "reverse greenhouse effect," tending to block the sun's heat and thus decrease the temperature of the earth. Particulates, along with the other pollutants mentioned above, can also damage health,

* During the Arab oil embargo of the winter of 1973-1974, the most common method for restricting gasoline sales was "odd-even rationing." With this method, people could buy gasoline only on odd-numbered or even-numbered days depending on whether the last number on their license plates was odd or even.

property, materials and vegetation. Nineteen seventy-seven air pollution damage costs by particulates are given below:*

Damage To	Cost (Billions of Dollars)
Health	$ 9.3
Residential Property	8.0
Materials/Vegetation	7.6
Total	$ 24.9

Carbon monoxide and sulfur dioxide are probably the most dangerous of the air pollutants. Carbon monoxide, produced primarily by the internal combustion engine used in automobiles, interferes with the ability of the blood to carry oxygen to the tissues of the body. The tissues most sensitive to oxygen deprivation are the heart and the brain. Sulfur dioxide is produced by the burning of fuel oil and coal containing sulfur inpurities. Sulfur dioxide damages vegetation, aquatic life, and building materials.

2. Land Waste issues currently center around an increase in the use of coal which will produce an increase in strip mining. Without proper reclamation, strip mining leaves the surface of the land scarred and unusable for agriculture, promotes erosion, and adds to water pollution from silt. Garbage dumps, slag piles, etc., are also involved.

3. Water pollution from energy production consists primarily of brine (salt water) and oil, which are water pollutants produced during the extraction and transportation of oil. Coal mining also produces brine, silt, and acids.

4. Radioactive waste, which must be buried underground for thousands of years, results from the production of electrical energy by nuclear power plants. These wastes might prove very harmful if they were to contaminate ground water. Radioactive pollution is also possible if accidents occur during the transport of nuclear material or during the operation of the plant.

* Source: President's Council on Environmental Quality, 4th Annual Report, September 1973.

EXERCISES ON THE U.S. ENERGY FUTURE

1. What effect does each of the decisions have on:

    a. Consumption of energy from each source by each user group

    b. Total U.S. energy consumption

    c. Consumption and reserves of domestic nonrenewable energy

    d. Pollution

2. According to FUTURE, will President Ford's energy plan work, i.e., will the decisions he indicated in his 1975 State of the Union Address lead to reduced dependence on imported fuel?

3. The President's plan involves both increasing the supply of oil from domestic sources (Decisions 1 through 4) and reducing the demand for oil and natural gas (Decisions 5 through 13). How effective is each by itself? Which is most effective in leading to reduced dependence on imported fuel?

4. How do the secondary effects of increasing the supply of oil compare to those of reducing demand? What are the secondary effects of the President's plan?

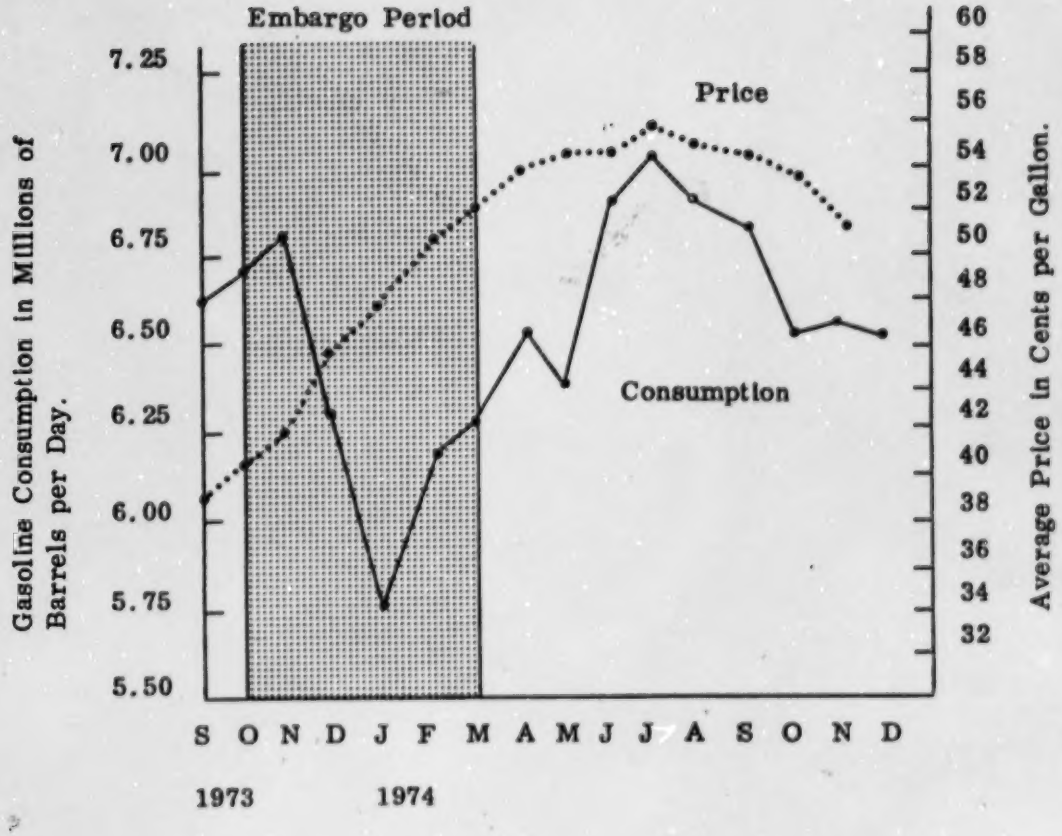
5. Can you develop a plan which would lead to reduced dependence on imported fuel at least as well as President Ford's plan, but would minimize the bad secondary effects? Try to optimize the tradeoff between supply, demand, economic effects and environmental effects.

6. Compare the primary and secondary effects of Decisions 6, 7, 8 and 9. Why would some members of Congress disagree with President Ford's choice of Decision 6 rather than 7, 8 or 9?

7. President Ford's plan assumes that higher prices for gasoline will reduce consumption. Look at the figure on the following page showing the relation of the price and consumption of gasoline from September 1973 to December 1974. Do you think that this assumption is reasonable? What would happen if gasoline consumption did not drop with a rise in price? Would you have to change the plan you developed in answering question 5?

8. Are there any decisions you would add to Program FUTURE? What about geothermal energy and solar energy? Information on these sources can be found in the list of references at the end of this booklet.

9. How does President Carter's energy plan differ from Project Independence? How are the two plans similar? What are the advantages of one plan over the other?



Conditions produced by the oil embargo.*

* Source: "Newsweek," January 27, 1975 and Federal Energy Administration

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APPENDICES

APPENDIX A

AN EXCERPT FROM THE STATE OF THE UNION ADDRESS, 1975

The economic disruption we and others are experiencing stems in part from the fact that the world price of petroleum has quadrupled in the last year.

But we cannot put all of the blame on the oil-exporting nations. We in the United States are not blameless. Our growing dependence upon foreign sources has been adding to our vulnerability for years and we did nothing to prepare ourselves for an event such as the embargo of 1973.

During the 1960's, this country had a surplus capacity of crude oil, which we were able to make available to our trading partners whenever there was a disruption of supply. This surplus capacity enabled us to influence both supplies and prices of crude oil throughout the world. Our excess capacity neutralized any effort at establishing an effective cartel, and thus the rest of the world was assured of adequate supplies of oil at reasonable prices.

In the 1960's, our surplus capacity vanished and, as a consequence, the latent power of the oil cartel could emerge in full force. Europe and Japan, both heavily dependent on imported oil, now struggle to keep their economies in balance. Even the United States, which is far more self-sufficient than most other industrial countries, has been put under serious pressure.

I am proposing a program which will begin to restore our country's surplus capacity in total energy. In this way, we will be able to assure ourselves reliable and adequate energy and help foster a new world energy stability for other major consuming nations.

But this nation and, in fact, the world must face the prospect of energy difficulties between now and 1985. This program will impose burdens on all of us with the aim of reducing our consumption of energy and increasing production. Great attention has been paid to considerations of fairness and I can assure you that the burdens will not fall more harshly on those less able to bear them.

I am recommending a plan to make us invulnerable to cutoffs of foreign oil. It will require sacrifices. But it will work.

I have set the following national energy goals to assure that our future is as secure and productive as our past:

> --First, we must reduce oil imports by 1 million barrels per day by the end of this year and by 2 million barrels per day by the end of 1977.
>
> --Second, we must end vulnerability to economic disruption by foreign suppliers by 1985.

--Third, we must develop our energy technology and resources so that the United States has the ability to supply a significant share of the energy needs of the free world by the end of this century.

To attain these objectives, we need immediate action to cut imports. Unfortunately, in the short-term there are only a limited number of actions which can increase domestic supply. I will press for all of them.

I urge quick action on legislation to allow commercial production at the Elk Hills, California Naval Petroleum Reserve. In order that we make greater use of domestic coal resources, I am submitting amendments to the Energy Supply and Environmental Coordination Act which will greatly increase the number of power plants that can be promptly converted to coal.

Voluntary conservation continues to be essential, but tougher programs are also needed--and needed now. Therefore, I am using presidential powers to raise the fee on all imported crude oil and petroleum products.

Crude oil fee levels will be increased $1 per barrel on February 1, by $2 per barrel on March 1, and by $3 per barrel on April 1. I will take action to reduce undue hardship on any geographical region.

The foregoing are interim administrative actions. They will be rescinded when the necessary legislation is enacted.

To that end, I am requesting the Congress to act within 90 days on a more comprehensive energy tax program. It includes:

--Excise taxes and import fees totalling $2 per barrel on product imports and on all crude oil.

--Deregulation of new natural gas and enactment of a natural gas excise tax.

--Enactment of a windfall profits tax by April 1 to ensure that oil producers do not profit unduly. At the same time I plan to take Presidential Initiative to de-control the price of domestic crude oil on April 1.

The sooner Congress acts, the more effective the oil conservation program will be and the quicker the federal revenues can be returned to our people.

I am prepared to use presidential authority to limit imports, as necessary, to assure the success of this program.

I want you to know that before deciding on my energy conservation program, I considered rationing and higher gasoline taxes as alternatives. Neither would achieve the desired results and both would produce unacceptable inequities.

A massive program must be initiated to increase energy supply, cut demand and provide new standby emergency programs to achieve the independence we want by 1985.

The largest part of increased oil production must come from new frontier areas on the outer continental shelf and from the Naval Petroleum Reserve No. 4 in Alaska. It is the intention of this administration to move ahead with exploration, leasing and production on those frontier areas of the outer continental shelf where the environmental risks are acceptable.

Use of our most abundant domestic resource--coal--is severely limited. We must strike a reasonable compromise on environmental concerns with coal. I am submitting Clean Air Act amendments which will allow greater coal use without sacificing our clean air goals.

I vetoed the strip mining legislation passed by the last Congress. With appropriate changes, I will sign a revised version into law.

I am proposing a number of actions to energize our nuclear power program. I will submit legislation to expedite nuclear licensing and the rapid selection of sites.

In recent months, utilities have canceled or postponed over 60 per cent of planned nuclear expansion and 30 per cent of planned additions to nonnuclear capacity.

Financing problems for that industry are growing worse. I am therefore recommending that the one year investment tax credit of 12 per cent be extended an additional two years to specifically speed the construction of power plants that do not use natural gas or oil. I am also submitting proposals for selective changes in state utility commission regulations.

To provide the critical stability for our domestic energy production in the face of world price uncertainty, I will request legislation to authorize and require tariffs, import quotas or price floors to protect our energy prices at levels which will achieve energy independence.

Increasing energy supplies is not enough. We must also take additional steps to cut long-term consumption. I therefore propose:

--Legislation to make thermal efficiency standards mandatory for all new buildings in the United States. These standards would be set after appropriate consultation with architects, builders and labor.

--A new tax credit of up to $150 for those home owners who install insulation equipment.

--The establishment of an energy conservation program to help low income families purchase insulation supplies.

--Legislation to modify and defer automotive pollution standards for five years to enable us to improve new automobile gas mileage 40 per cent by 1980.

These proposals and actions, cumulative, can reduce our dependence on foreign energy supplies to 3 million to 5 million barrels per day by 1985.

To make the United States invulnerable to foreign disruption, I propose standby emergency legislation and a strategic storage program of 1 billion barrels of oil for domestic needs and 300 million barrels for defense purposes.

I will ask for the funds needed for energy research and development activities. I have established a goal of 1 million barrels of synthetic fuels and shale oil production per day by 1985 together with an incentive program to achieve it.

I believe in America's capabilities. Within the next 10 years, my program envisions:

--200 major nuclear power plants

--250 major new coal mines

--150 major coal-fired power plants

--30 major new oil refineries

--20 major new synthetic fuel plants

--the drilling of many thousands of new oil wells

--the insulation of 18 million homes

--and construction of millions of new automobiles, trucks and buses that use much less fuel.

We can do it. In another crisis--the one in 1942--President Franklin D. Roosevelt said this country would build 60,000 aircraft. By 1943, production had reached 125,000 airplanes annually.

If the Congress and the American people will work with me to attain these targets, they will be achieved and surpassed.

APPENDIX B

TABLE OF CONVERSIONS

British Thermal Unit (BTU) = The amount of heat required to raise one pound of water one degree Fahrenheit.

1 BTU = 778.2 foot-pounds

= 3.93×10^4 horsepower hours

= .252 kilogram-calories

= 2.93×10^4 kilowatt hours

FUEL	COMMON MEASURE	BTU's
Crude Oil	Barrel (42 Gallons)	5,800,000
Natural Gas	Cubic Foot	1,032
Coal	Ton	25,000,000*
Electricity	Kilowatt-Hour	3,412

* Approximate